SEP 24 2012

510(k) Summary K121021

In accordance with 21 CFR 807.92 the following updated summary of information is provided with the additional non-clinical analysis performed as a result of a request for additional information by FDA:

Date: September 18, 2012

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Device Trade Name: INOmax DS_{IR}® (Delivery System)

Common/Usual Name: Nitric Oxide Administration Apparatus (primary)
Nitric Oxide Administration Apparatus, Back-up System
Nitric Oxide Analyzer
Nitrogen Dioxide Analyzer

Classification Names: Apparatus, Nitric Oxide Delivery, or Apparatus, Nitric Oxide Backup Delivery, Class II – 21 CFR 868.5165

Product Code: MRN (Primary), MRQ, MRP

Predicate Device(s): K061901, K070867, K071516, K080484, K081691, K090958, K092545, K093922, K110344, K110635, K113272

Device Description: The INOmax DS_{IR}® uses a "dual-channel" design to ensure the safe delivery of INOmax®. The first channel has the delivery CPU, the flow controller and the injector module to ensure the accurate delivery of NO. The second channel is the monitoring system, which includes a separate monitor CPU, the gas cells (NO, NO_2, and O_2 cells) and the user interface including the display and alarms. The dual-channel approach to delivery and monitoring permits INOmax® delivery independent of monitoring but also allows the monitoring system to shutdown INOmax® delivery if it detects a fault in the delivery system such that the NO concentration could become greater than 100 ppm. The delivery system

can also shut down delivery if it detects certain serious problems with the monitoring system.

Intended Use: The INOmax® DS delivery system delivers INOMAX® (nitric oxide for inhalation) therapy gas into the inspiratory limb of the patient breathing circuit in a way that provides a constant concentration of nitric oxide (NO), as set by the user, to the patient throughout the inspired breath. It uses a specially designed injector module, which enables tracking of the ventilator waveforms and the delivery of a synchronized and proportional dose of NO. It may be used with most ventilators.

The INOmax® DS provides continuous integrated monitoring of inspired O_2, NO_2, and NO, and a comprehensive alarm system.

The INOmax® DS incorporates a battery that provides up to 6 hours of uninterrupted NO delivery in the absence of an external power source.

The INOmax® DS includes a backup NO delivery capability that provides a fixed flow of 250 mL/min of NO which along with user supplied 10 L/min of oxygen provides 20 ppm in the gas flow to a patients breathing circuit. It may also use the INOblender® for backup.

The target patient population is controlled by the drug labeling for INOmax® and is currently neonates. The primary targeted clinical setting is the Neonatal Intensive Care Unit (NICU) and secondary targeted clinical setting is the transport of neonates.

Technology: All revisions of INOmax DS_{IR}® utilize component technology to deliver Nitric Oxide gas to the patient. The components consist of the Delivery System unit, the blender, a stand/cart and the NO gas tanks. In this revision of the INOmax DS_{IR}®, the software and labeling have been updated.

Determination of Substantial Equivalence: Comparison to Predicate Device:
The INOmax DS_{IR}® with modified software and labeling has the same intended use as the cleared INOmax DS_{IR}®. All features are identical except those described in the table below.

Feature / Specification	**INOmax DS_{IR} - K113272**	**INOmax DS_{IR} with modified software and additional respiratory care devices.**
Alarms/Alerts	Low Battery	The Smart Battery within the INOmax DS_{IR}® reports the time remaining to the Monitoring Processor. The Low Battery alarm threshold limit was changed from 30 minutes to 60 minutes in the software to provide additional margin to the system electronics. From the user perspective the alarm limit is still 30 minutes. Shutdown of the device when operating on battery is not dependent on the Low Battery alarm, therefore the length of runtime when operating on battery remains unchanged.
	Delivery Failure for NO >100 ppm	The NO > 100 ppm condition must be present for 12 continuous seconds at monitored NO > 100 ppm before alarm and delivery shutdown. The 12 second timer will be reset when a sampling blackout occurs. The change in time to 12 seconds, from zero seconds was made to prevent loss of delivery conditions during transient monitored NO values briefly exceeding 100 ppm.
	Delivery Failure for NO >2x set point	To prevent loss of delivery during transient conditions, the overdelivery condition of NO > 2x setpoint must be present for 12 continuous seconds (versus 0 seconds in the prior software version) at monitored NO > 2x setpoint before alarm and delivery shutdown.
	Delivery Failure for Under Delivery	Under Delivery Alarm added. To prevent loss of delivery during transient conditions, the under delivery condition must be present for 12 consecutive seconds to trigger the under delivery alarm. In the previous version, the system would immediately shut-down as soon as the under delivery condition was detected.
	Delivery Failure	Three system voltage conditions during which this alarm was triggered have been eliminated.
RS-232 Port Configuration	Not applicable.	RS-232 communications via the existing port were added to allow system data to be downloaded to third party data collection systems (such as Capsule Tech, K032142).
Labeling for compatibility with respiratory care devices	A variety of transport, neonatal, adult/ped, high frequency and anesthesia ventilators, nasal CPAP and nasal high flow cannulas.	Additional respiratory care devices include: Fisher & Paykal Infant Circuit Nasal Cannula (K020332) Fisher and Paykal Optiflow Breathing Circuit (K983112) A-Plus Medical Babi Plus Bubble CPAP (K110471)

Summary of Non-Clinical Tests:

The following quality assurance measures were applied to the modification of the system:

- Risk Analysis
- Requirements Reviews
- Design Reviews
- Testing on unit level (Module verification)
- Integration testing (System verification)
- Performance testing (Verification)
- Safety testing (Verification)

Support for the substantial equivalence of the INOmax $DS_{IR}^{®}$ was provided as a result of risk management and testing which included electrical safety, performance and software tests. This testing includes conformity to the FDA recognized consensus standards and voluntary standards as follows:

- IEC 60601-1:1988 + A1:1991 + A2:1995: Medical electrical equipment - Part 1: General requirements for basic safety and essential performance
- IEC 60601-1-2: 2001 (2nd Edition, Am 1) General requirements for safety – Collateral standard: Electromagnetic compatibility – Requirements and tests
- IEC 60601-1-4:2000-04 General Requirements for Safety-Collateral Standard: Programmable Electrical Medical Systems
- IEC 60601-1-8:2006 General requirements for basic safety and essential performance – Collateral Standard: General requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems.

Software verification confirmed the INOmax $DS_{IR}^{®}$ is compliant with its system level requirements, that the new/modified alarms function as specified and that data can be correctly communicated to third part data collection devices via the existing RS-232 port.

To confirm compatibility with the three new respiratory care devices, these devices were set up and calibrated according to the manufacturer's recommendations, and tested using the settings established for each device. The INOmax $DS_{IR}^{®}$ was set up and calibrated according to the manufacturer's recommendations.

Five INOmax $DS_{IR}^{®}$ settings were used [0 (baseline), 5, 20, 40, and 80 ppm] for each setting and mode of ventilation.

The measured values on the INOmax $DS_{IR}^{®}$ were also recorded along

with any anomalies found.

The testing concluded four requirements necessary for the operation of the INOmax DS_{IR}® and the three respiratory care devices to be compatible:

- O_2 dilution
- Effect on respiratory care device
- INOmax DS_{IR}® delivery accuracy
- NO_2 generation

Testing with the Fisher & Paykel circuits additionally concluded proper function during backup delivery.

While the delivery control mechanism was not changed in the modifications for the version 2.1 software, an analysis was conducted to characterize the performance of the closed-loop control system and to compare the version 2.1 control system to that of the predicate device. This analysis incorporated the following elements:

- INOmax DS_{IR}® control system theory of operation
- Identification of the control system input/output relationships
- Frequency response of the control system in normal device operation
- Stability/sensitivity analysis demonstrating the response of the control system using worst-case flow inputs and the handling of disturbances and component failures
- Graphical presentation showing time-domain responses of overshoot and undershoot across various ventilator flow rates and flow profiles
- Demonstration of control system safety information in the device labeling

Summary of Clinical Tests:

The subject of this premarket submission, INOmax DS_{IR}®, with revised software and interfaced to each of the selected respiratory care devices, did not require clinical studies to support substantial equivalence.

Conclusion: INO Therapeutics/Ikaria considers the INOmax DS_{IR}® to be as safe and as effective as the predicate device, with performance substantially equivalent to the predicate device.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Public Health Service

Food and Drug Administration
10903 New Hampshire Avenue
Document Control Room –WO66-G609
Silver Spring, MD 20993-0002

SEP 24 2012

INO Therapeutics
Mr. David Trueblood
Director, Regulatory Affairs
2902 Dairy Drive
Madison, Wisconsin 53718

Re: K121021
Trade/Device Name: INOmax DS_{IR}® (Delivery System)
Regulation Number: 21 CFR 868.5165
Regulation Name: Nitric Oxide Administration Apparatus
Regulatory Class: II
Product Code: MRN, MRQ, MRP
Dated: August 13, 2012
Received: August 14, 2012

Dear Mr. Trueblood:

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration. Please note: CDRH does not evaluate information related to contract liability warranties. We remind you, however, that device labeling must be truthful and not misleading.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR Part 820); and if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

If you desire specific advice for your device on our labeling regulation (21 CFR Part 801), please go to http://www.fda.gov/AboutFDA/CentersOffices/CDRH/CDRHOffices/ucm115809.htm for the Center for Devices and Radiological Health's (CDRH's) Office of Compliance. Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21CFR Part 807.97). For questions regarding the reporting of adverse events under the MDR regulation (21 CFR Part 803), please go to http://www.fda.gov/MedicalDevices/Safety/ReportaProblem/default.htm for the CDRH's Office of Surveillance and Biometrics/Division of Postmarket Surveillance.

You may obtain other general information on your responsibilities under the Act from the Division of Small Manufacturers, International and Consumer Assistance at its toll-free number (800) 638-2041 or (301) 796-7100 or at its Internet address http://www.fda.gov/MedicalDevices/ResourcesforYou/Industry/default.htm.

Sincerely yours,

for

Anthony D. Watson, B.S., M.S., M.B.A.
Director
Division of Anesthesiology, General Hospital,
Infection Control and Dental Devices
Office of Device Evaluation
Center for Devices and
Radiological Health

Enclosure

510(k) Number (if known):

Device Name: INOmax® DS

Indications for Use:

The INOmax® DS delivery system delivers INOmax® (nitric oxide for inhalation) therapy gas into the inspiratory limb of the patient breathing circuit in a way that provides a constant concentration of nitric oxide (NO), as set by the user, to the patient throughout the inspired breath. It uses a specially designed injector module, which enables tracking of the ventilator waveforms and the delivery of a synchronized and proportional dose of NO. It may be used with most ventilators.

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Prescription Use_X___ AND/OR Over-The-Counter Use_ _
(Part 21 CFR 801 Subpart D) (Part 21 CFR 801 Subpart C)

(PLEASE DO NOT WRITE BELOW THIS LINE - CONTINUE ON ANOTHER PAGE IF NEEDED)

Concurrence of CDRH, Office of Device Evaluation (ODE)

(Division Sign-Off)
Division of Anesthesiology, General Hospital Infection Control, Dental Devices

510(k) Number: K121021